

## ***PMP15005 Test Results***

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**Test Data**

**PMP15005**



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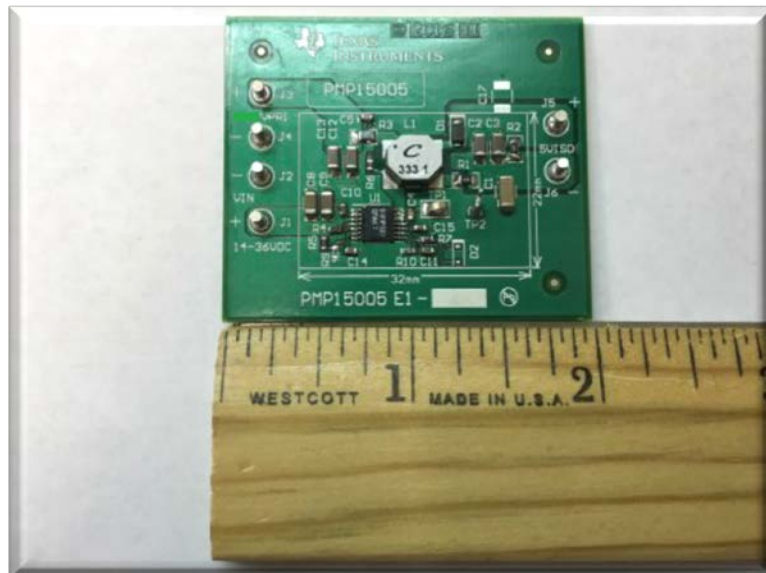
## Circuit Description

PMP15005 uses the LM5160 in a Fly-Buck topology with the primary and secondary output both set to 5V nominal. The circuit accommodates a voltage input range from 14V to 36V, ideal for the 24-V nominal input rail. While the primary side is set at 5.4V nominally, using the feedback resistors, the secondary isolated side sees 5V, based on Coilcraft's LPD8035V series coupled inductor set at a turns-ratio of 1:1. The maximum operating current on both the primary and secondary rails are set at 225mA each. The switching frequency is set at 300 kHz nominal.

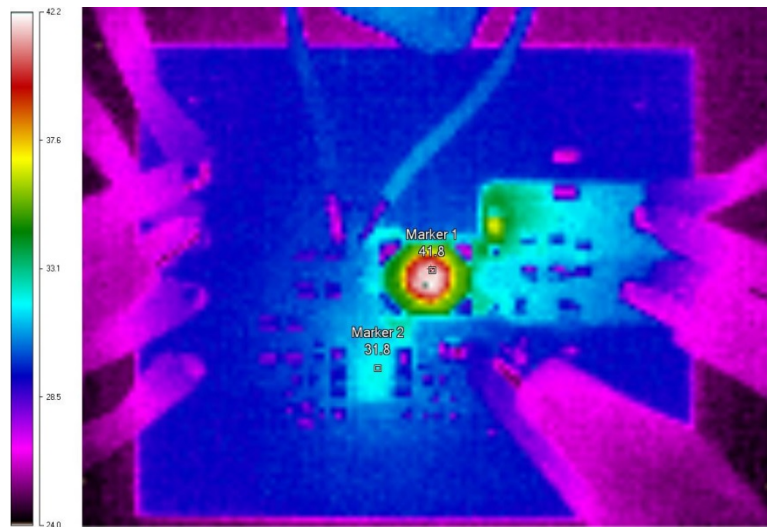
## Power Specification

<b>V<sub>IN</sub> Min.</b>	<b>14-V</b>
<b>V<sub>IN</sub> Max.</b>	<b>36-V</b>
<b>V<sub>OUT,PRI</sub></b>	<b>5-V (±1%)</b>
<b>V<sub>OUT,SEC</sub></b>	<b>5-V (±10%)</b>
<b>I<sub>OUT,PRI</sub></b>	<b>0-A-0.225-A</b>
<b>I<sub>OUT,SEC</sub></b>	<b>0-A-0.225-A</b>
<b>Approximate Switching Frequency</b>	<b>≈300 KHz</b>

## Board Photo (with LM5160)

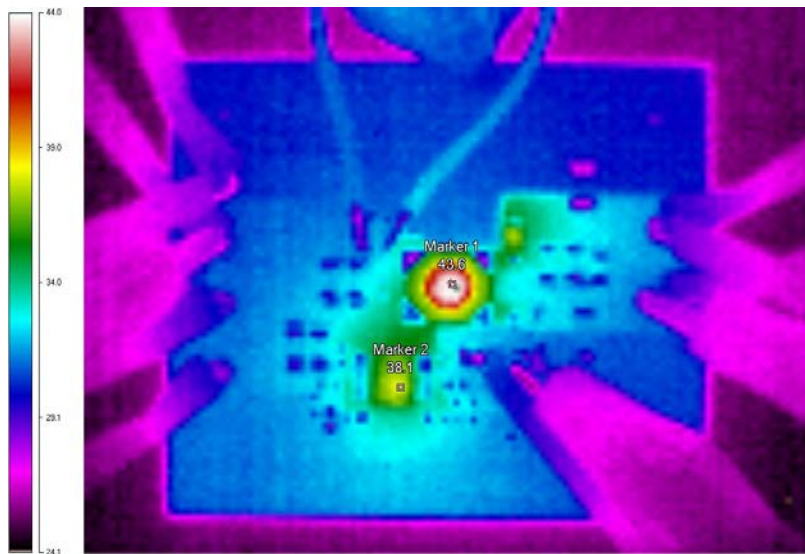


### Thermal Image of the EVM at 14VIN & $I_{PRI}=I_{SEC}=0.225A$



The Marker 1 in the picture above represents the surface of the coupled inductor and the Marker 2 represents the IC. As seen in the picture the coupled inductor is the hottest part on the board during the operation.

### Thermal Image of the EVM at 36VIN & $I_{PRI}=I_{SEC}=0.225A$



The Marker 1 in the picture above represents the surface of the coupled inductor and the Marker 2 represents the IC. As seen in the picture the coupled inductor is the hottest component on the board during the operation.

## Efficiency Data

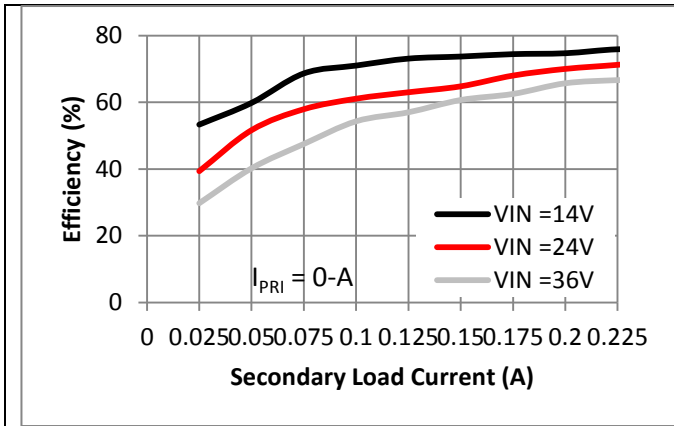


Figure 1. Efficiency with  $I_{PRI}$  set at 0A load and  $I_{SEC}$  increasing from 0.025A to 225mA

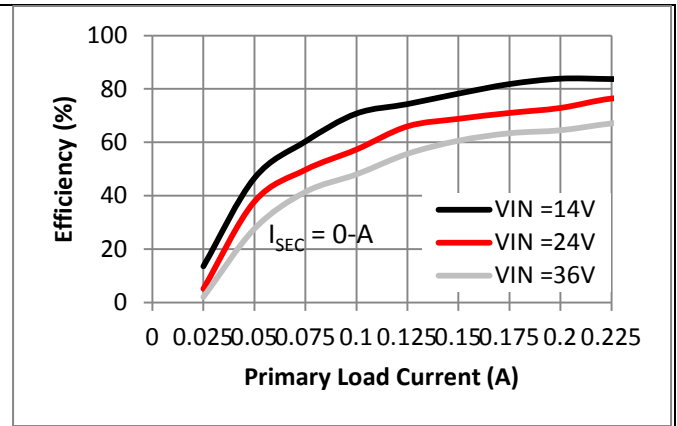


Figure 2. Efficiency with  $I_{SEC}$  set at 0A load and  $I_{PRI}$  increasing from 0.025A to 225mA

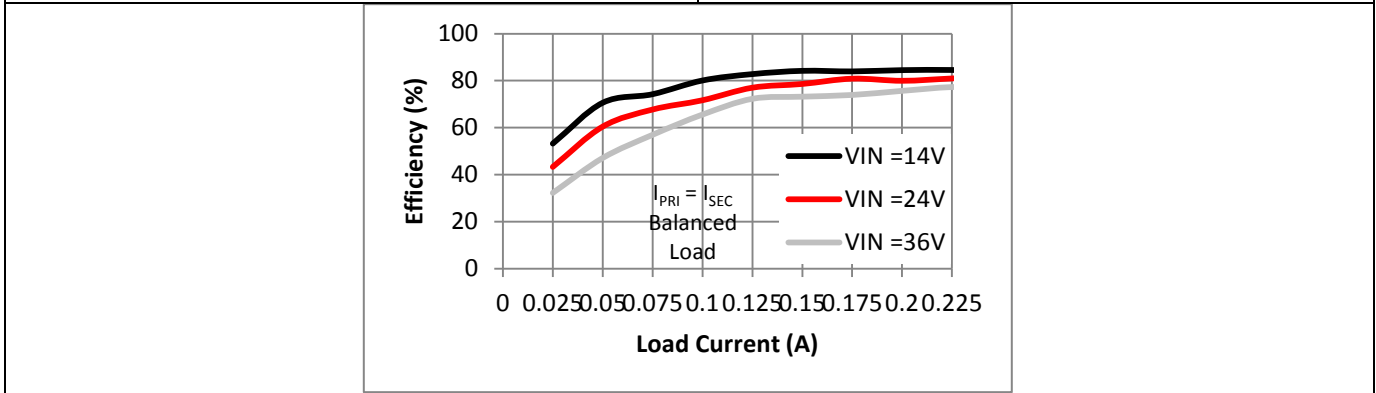


Figure 3. Efficiency with  $I_{PRI} = I_{SEC} = \text{Load Current}$  increased from 0.025A to 0.225A on each rail

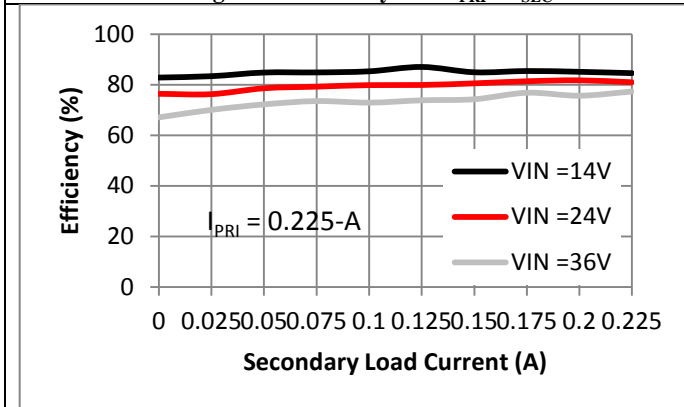


Figure 4. Efficiency with  $I_{PRI}$  set at 225mA load and  $I_{SEC}$  increasing from 0A to 225mA

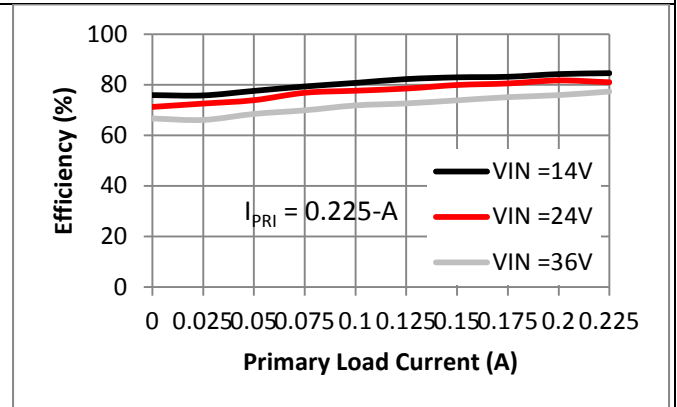
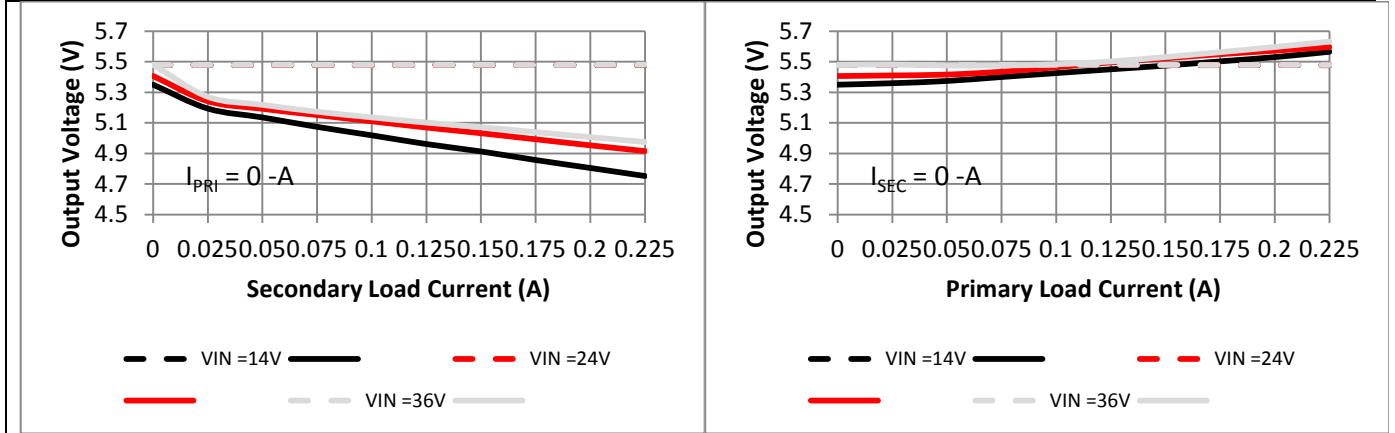


Figure 5. Efficiency with  $I_{SEC}$  set at 225mA load and  $I_{PRI}$  increasing from 0A to 225mA

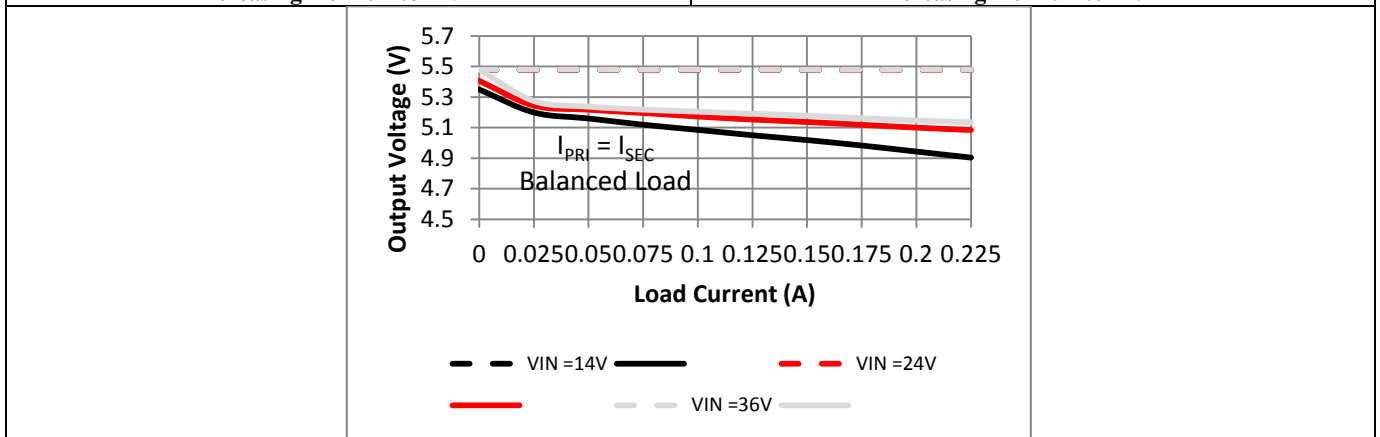
## Load Regulation Data

Dotted line plots (- - -) show  $V_{PRI}$  and the solid line plots show  $V_{SEC}$  (unless specified otherwise).

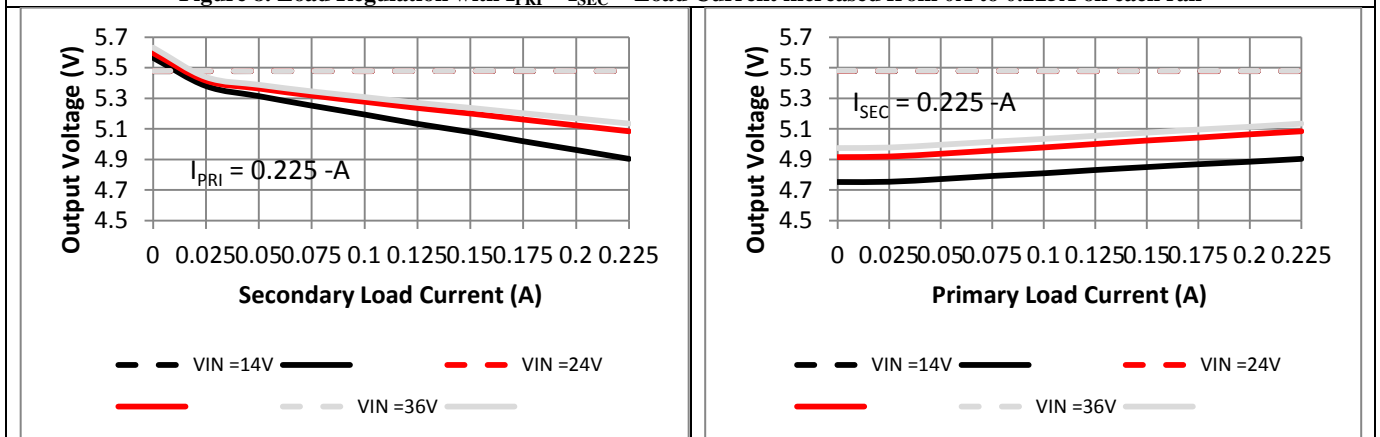


**Figure 6. Load Regulation with  $I_{PRI}$  set at 0A and  $I_{SEC}$  increasing from 0A to 225mA**

**Figure 7. Load Regulation with  $I_{SEC}$  set at 0A and  $I_{PRI}$  increasing from 0A to 225mA**



**Figure 8. Load Regulation with  $I_{PRI} = I_{SEC} = \text{Load Current}$  increased from 0A to 0.225A on each rail**



**Figure 9. Load Regulation with  $I_{PRI}$  set at 225mA load and  $I_{SEC}$  increasing from 0A to 225mA**

**Figure 10. Load Regulation with  $I_{SEC}$  set at 225mA load and  $I_{PRI}$  increasing from 0A to 225mA**

## Line Regulation Data

Dotted line plots (- - -) =  $V_{PRI}$  and the solid line plots =  $V_{SEC}$  (unless specified).

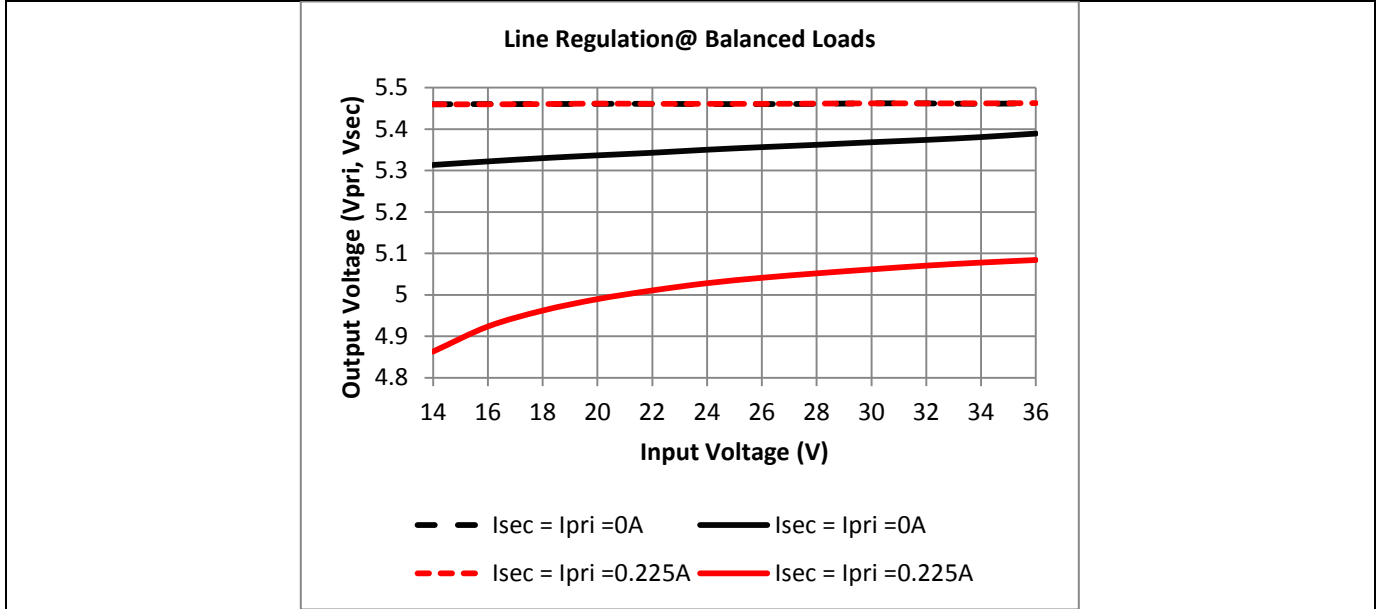


Figure 11. Line Regulation with  $I_{SEC} = I_{PRI}$  (Balanced Loads)

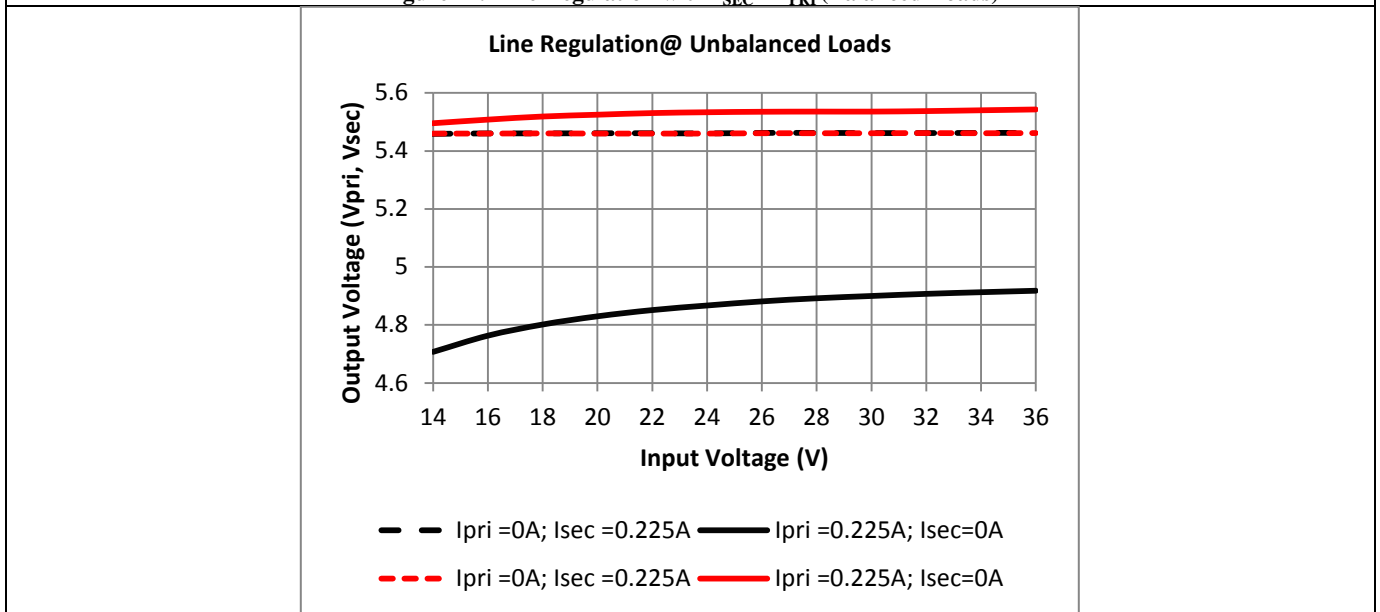


Figure 12. Line Regulation with  $I_{SEC} \neq I_{PRI}$  (Unbalanced Loads; Unloaded one rail while fulling loading the other rail)

## Start Up

Test condition:  $V_{IN} = 24V$ , both outputs set at No load (0mA on Primary and Secondary).

**C1 (Yellow) –  $V_{IN}$**

**C2 (Red) –  $I_{PRI}$  : Primary Coupled Inductor Winding Current**

**C3 (Blue) –  $V_{SEC}$  (5.45V)**

**C4 (Green) –  $V_{PRI}$  (5.48V)**



**Figure 13. Startup at No load**

Test condition:  $V_{IN} = 24V$ , both outputs set at Full load (225mA on Primary and Secondary).

**C1 (Yellow) –  $V_{IN}$**

**C2 (Red) –  $I_{PRI}$  : Primary Coupled Inductor Winding Current**

**C3 (Blue) –  $V_{SEC}$  (5.1V)**

**C4 (Green) –  $V_{PRI}$  (5.48V)**



**Figure 14. Startup at Full load**



## Load Transients

### $V_{SEC}$ Load Step @ $I_{PRI} = 0\text{-A}$

Test condition:  $V_{IN} = 24\text{V}$  with  $I_{PRI}$  set to  $0\text{A}$ .

**CH1 (Yellow)** -  $I_{SEC}$  = load step from  $150\text{mA}$  to  $300\text{mA}$  with slew rate set to  $500\text{mA/us}$

**CH3 (Blue)** -  $V_{SEC}$  (AC coupled);  $\Delta V_{SEC} = 210\text{mV}$  peak to peak

**CH4 (Green)** -  $V_{PRI}$  (AC coupled);  $\Delta V_{PRI} = 25\text{mV}$  peak to peak

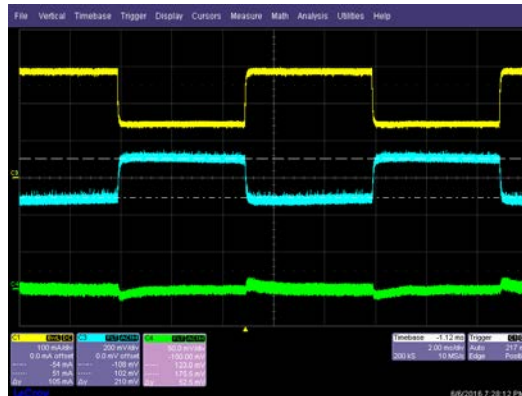


Figure 15. Secondary Side Load Transient at No load on Primary

### $V_{SEC}$ Load Step @ $I_{PRI} = 150\text{-mA}$

Test condition:  $V_{IN} = 24\text{V}$  with  $I_{PRI}$  set to  $150\text{mA}$ .

**CH1 (Yellow)** -  $I_{SEC}$  = load step from  $150\text{mA}$  to  $300\text{mA}$  with slew rate set to  $500\text{mA/us}$

**CH3 (Blue)** -  $V_{SEC}$  (AC coupled);  $\Delta V_{SEC} = 208\text{mV}$  peak to peak

**CH4 (Green)** -  $V_{PRI}$  (AC coupled);  $\Delta V_{PRI} = <25\text{mV}$  peak to peak

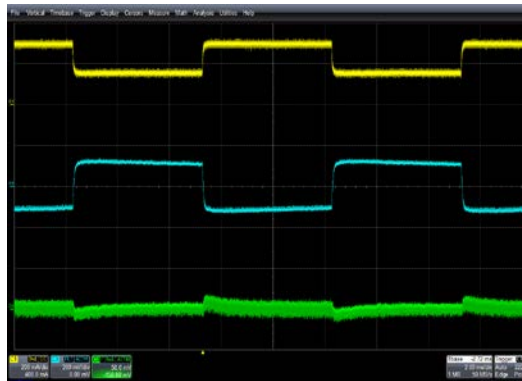


Figure 16. Secondary Side Load Transient at 150mA load on Primary

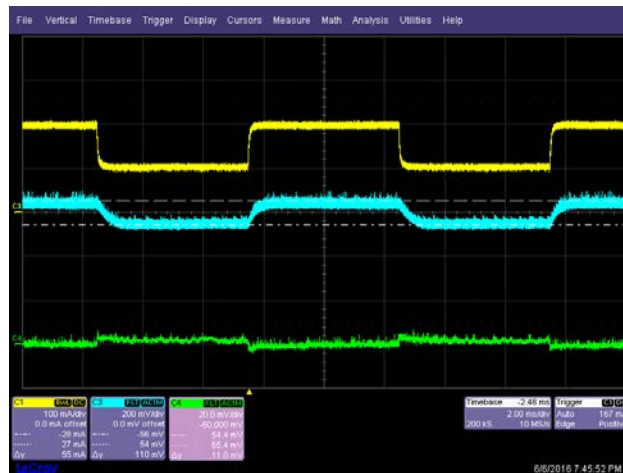
### **$V_{PRI}$ Load Step @ $I_{SEC} = 0\text{-A}$**

Test condition:  $V_{IN} = 24\text{V}$  with  $I_{SEC}$  set to  $0\text{A}$

**CH1 (Yellow) -  $I_{PRI} = 100\text{mA}$  to  $200\text{mA}$  with slew rate set to  $500\text{mA/us}$**

**CH3 (Blue) -  $V_{SEC}$  (AC coupled);  $\Delta V_{SEC} = 110\text{mV}$  peak to peak**

**CH4 (Green) -  $V_{PRI}$  (AC coupled);  $\Delta V_{PRI} = 10\text{mV}$  peak to peak**



**Figure 17. Primary Side Load Transient at no load on Secondary**

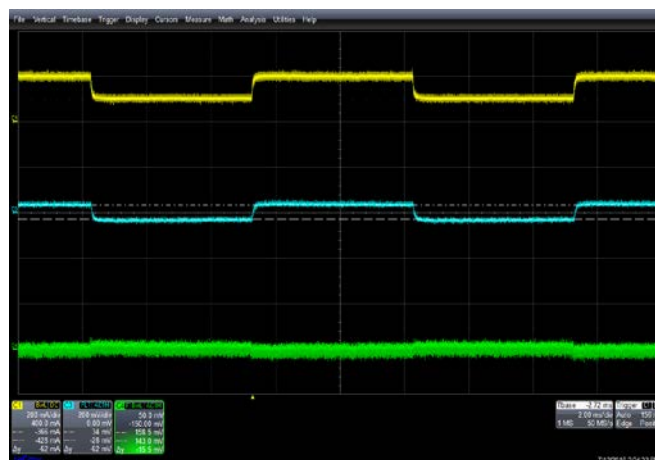
### **$V_{PRI}$ Load Step @ $I_{SEC} = 150\text{-mA}$**

Test condition:  $V_{IN} = 24\text{V}$  with  $I_{SEC}$  set to  $150\text{mA}$

**CH1 (Yellow) -  $I_{PRI} = 100\text{mA}$  to  $200\text{mA}$  with slew rate set to  $500\text{mA/us}$**

**CH3 (Blue) -  $V_{SEC}$  (AC coupled);  $\Delta V_{SEC} = 60\text{mV}$  peak to peak**

**CH4 (Green) -  $V_{PRI}$  (AC coupled);  $\Delta V_{PRI} = <15\text{mV}$  peak to peak**



**Figure 18. Primary Side Load Transient at 150mA load on Secondary**

## SW Node and Output Voltage Ripple Waveforms

Test condition:  $V_{IN} = 36V$ , both outputs set to full load (225mA on Primary and on Secondary).

**C1 (Yellow) - Switch node**

**C2 (Red) -  $I_{PRI}$  : Primary Coupled Inductor Winding Current**

**C3 (Blue) -  $V_{SEC}$  (DC coupled):  $\Delta V_{SEC} < 100mV$  peak to peak**

**C4 (Green) -  $V_{PRI}$  (AC coupled):  $\Delta V_{PRI} < 80mV$  peak to peak**



**Figure 19. Steady State at Full Load**

## Short Circuit Test

A short circuit on either output may result in failure to the LM5160. The saturation current rating of the coupled inductor used is lower than the typical current limit of the IC. Should a short circuit occur, this will result in saturation of the coupled inductor. For applications that require short circuit protection, it is strongly recommended that a coupled inductor with higher saturating currents above 2.5A, be used.

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